

California Environmental Protection Agency



***Modified* ~~PROPOSED~~ FOR ADOPTION**

Vapor Recovery Test Procedure

TP-201.1E

**Leak Rate and Cracking Pressure of
Pressure/Vacuum ~~RELIEF~~ Vent Valves**

Adopted: _____

Note: This method is proposed for adoption. As authorized by title 2, California Code of Regulations, section 8, the method is shown without underline. All text is proposed for adoption. Proposed 15-day changes (July 17, 2003) are shown with ***bold italic*** for addition and ~~SMALL CAP STRIKEOUT~~ for deletion.

California Environmental Protection Agency
Air Resources Board

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TP-201.1E

Leak Rate and Cracking Pressure of Pressure/Vacuum ~~RELIEF~~ Vent Valves

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

For the purpose of this procedure, the term "CARB" refers to the ~~STATE OF~~ California Air Resources Board, and the term "Executive Officer" refers to the CARB Executive Officer or his or her authorized representative or designate.

1. PURPOSE AND APPLICABILITY

The purpose of this procedure is to determine the pressure and vacuum at which a Pressure-/Vacuum Vent Valve (~~PV~~ **P/V** Valve) actuates, and to determine the volumetric leak rate at a given pressure as specified *in CP-201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities* ~~BY CERTIFICATION PROCEDURE 201 (CP-201)~~. This procedure is applicable for certification and compliance testing of ~~PV~~ **P/V** Valves.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The volumetric leak rate of a ~~PV~~ **P/V** Valve is determined by measuring the positive and negative flow rates at corresponding pressures. *The positive and negative cracking pressures of the valve are determined by measuring the pressure at which the P/V Valve opens to atmospheric pressure. With the exception of certification testing performed by the Executive Officer, these measurements are determined by removing the P/V Valve and conducting the test on a test stand.* ~~THIS IS ACCOMPLISHED BY USING A~~ A flow metering device *is used* to introduce ~~A KNOWN~~ flow ~~INTO A TEST STAND~~ while measuring pressure.

3. BIASES AND INTERFERENCES

3.1 Installing a ~~PV~~ **P/V** Valve onto the test stand in a manner that is not in accordance with the manufacturer's recommended installation instructions can produce erroneous results.

3.2 Leaks in the test stand or test equipment can produce erroneous results.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Electronic Pressure Measuring Device. *Minimum* ~~S~~sensitivity shall be 0.01 inches H₂O with a maximum full-scale range of 20 inches H₂O and minimum accuracy of *plus or minus* 0.50 percent *full-scale range*.

4.2 Flow Meter. *The measurable leak rate is dependent upon the sensitivity, range and precision of the flow meter used for testing. For electronic flow metering devices, the minimum sensitivity shall be 1.0 ml/min (0.0021 CFH) with a minimum full-scale accuracy of ± 1.0 percent. For rotameters, the flow meter minimum sensitivity shall be 12.5 ml/min (.026 CFH) with minimum accuracy of ± 5 percent full-scale. The device scale shall be 150mm (5.91 inches) tall to provide a sufficient number of graduations for readability.* ~~ELECTRONIC FLOW METERING DEVICE. MINIMUM SENSITIVITY SHALL BE 1.0 ML/MIN WITH A MAXIMUM FULL-SCALE RANGE OF 200 ML/MIN AND MINIMUM ACCURACY OF ± 1.0 PERCENT OF FULL-SCALE.~~

~~4.3 FLOW METERING DEVICE (I.E., ROTAMETERS). MINIMUM SENSITIVITY SHALL BE 15 ML/MIN (.005 CFH) WITH A MAXIMUM FULL-SCALE RANGE OF 300 ML/MIN AND MINIMUM ACCURACY OF ± 5 PERCENT. THE DEVICE SCALE SHALL BE A MINIMUM OF 150MM (5.91 INCHES) TALL TO PROVIDE A SUFFICIENT NUMBER OF GRADUATIONS FOR ACCURATE READABILITY.~~

5. EQUIPMENT

5.1 Nitrogen. Use commercial grade gaseous nitrogen in a high-pressure cylinder equipped with a pressure regulator and one (1.00) psig pressure relief valve. As an alternative, compressed air may be used to pressurize to the minimum working pressure required by the Flow Metering device.

5.2 Ballast Tank. If required, use a commercially available ~~AIR~~ tank (2 gallon minimum), capable of being pressurized or evacuated (placed under vacuum) to the minimum working pressure required by the flow-metering device(s).

5.3 Vacuum Pump or Vacuum Generating Device. Use a commercially available vacuum pump or equivalent, capable of evacuating the ~~STEEL~~ ballast tank or test stand to the minimum working pressure required by the flow-metering device.

5.4 Electronic Pressure Gauge. Use ~~A DWYER MODEL 475 MARK III SERIES OR EQUIVALENT,~~ **an** electronic pressure gauge **or digital manometer** that conforms to the minimum requirements listed in section 4 to measure the pressure inside of the test stand.

5.5 Flow Metering Device(s). Use either an electronic flow-metering device or Rotameter as described below to measure or introduce a volumetric flow rate. Although the use of either type of instrument is allowed, electronic flow metering devices provide higher accuracy and precision. For the purpose of certification testing, only electronic flow metering devices shall be used.

5.5.1 Electronic Flow Metering Device. Use a Mass Flow Meter, ~~AALBORG GFM-05 OR EQUIVALENT~~ that conforms to the minimum requirements listed in section 4 to introduce nitrogen or compressed air into the test stand. The Mass Flow Meter shall be equipped with a high precision needle valve to accurately adjust the flow settings. The meter may be used for both positive and negative flow rates by reconfiguring the pressure or vacuum lines.

5.5.2 Rotameters. Two (2) devices required. Use two ~~AALBORG~~ Flow Meters, ~~TUBE NUMBER 032-41C OR EQUIVALENT~~ with minimum specifications **described** in Section 4 to measure or introduce flow rates. One meter shall use a needle valve oriented for introducing positive flow and the other using an inverted needle valve for introducing vacuum.

5.6 Test Stand. *If a bench test arrangement is used, Use a test stand as shown in Figure 1, or equivalent, equipped with a 2-inch NPT threaded pipe on at least one end for attaching the ~~P/V~~ P/V Valve in an upright position. If other than 2-inch NPT is required, use an adaptor to reduce or enlarge the 2 inch pipe.* The test stand shall be equipped with at least two (2) ports used for introducing flow and measuring pressure. *Use a bypass valve to enable the tester to set the required flow without pressurizing the P/V Valve. Once the required flow rate is set, the bypass valve shall be closed to route the flow into the stand and pressurize the P/V Valve to check cracking pressure.* Test stands may be constructed of various materials or dimensions. *For certification testing conducted by Executive Officer only, the P/V valve may be isolated and tested in place at the facility.*

6. PRE-TEST PROCEDURES

- 6.1** All pressure measuring device(s) shall be bench calibrated using a reference gauge, incline manometer or NIST traceable standard at least once every six (6) months. Calibration shall be performed at 20, 50, and 80 percent of full scale. Accuracy shall be within five (5) percent at each of these calibration points.
- 6.2** Electronic pressure measuring devices shall be calibrated immediately prior to testing using the zero gauge pressure adjustment knob located on the instrument.
- 6.3** The Flow Metering device(s) shall be calibrated using a reference meter or NIST traceable standard. Calibrations shall be performed at 20, 50, and 80 percent of full-scale range and shall take place at a minimum of once every six (6) months.
- 6.4** Leak check the test stand **or test assembly** prior to installing the ~~P/V~~ P/V Valve.
- (a) Install a 2-inch cap onto the NPT threads in place of the ~~P/V~~ P/V Valve using pipe sealant or Teflon tape.
 - (b) Check all fittings for tightness and proper assembly.
 - (c) Slowly establish a stable gauge pressure in the test stand between 18.00 and 20.00 inches water column and allow pressure to stabilize.
 - (d) Check for leaks by applying a leak detection solution around all fittings and joints and by observing the pressure for pressure changes that may identify a leak. **If no bubbles form, the test stand is leak tight.**

- (e) If soap bubbles form or the test stand pressure will not stabilize, repeat (a) through (d); it may be necessary to place the test apparatus in an environment that is free from the effects of wind or sunlight.

TEST PROCEDURE

- 7.1 Install the ~~PV~~ **P/V** Valve ~~ON THE TEST STAND~~ in an upright position following the installation instructions provided by the manufacturer. Incorrectly installing the valve ~~ON THE TEST STAND~~ will invalidate any pressure versus flow rate measurement.
- 7.2 ~~TWO-INCH~~ **Positive** Leak Rate. Slowly open the control valve on the Positive Flow Metering device until the pressure ~~IN THE TEST STAND~~ stabilizes at **the positive leak rate pressure described in CP-201 section 3** ~~POSITIVE TWO (2.00) INCHES H₂O~~. Maintain steady state pressure ~~AT 2.00 INCHES H₂O~~ by using the control valve for at least ~~THIRTY~~ **ten (30)** seconds. Steady state flow is indicated by a pressure change of no more than 0.05 inches H₂O on the pressure gauge. Record the final flow rate on the data sheet and close the control valve.
- 7.3 Positive Cracking Pressure. **Open the bypass valve to route the flow outside of the test assembly.** Open the control valve on the Positive Flow Metering device to establish a flow rate of 120 ml/min. **Once flow is stabilized, close the bypass valve to route the flow into the test assembly.** Observe the ~~TEST STAND~~ pressure. The ~~PV~~ **P/V** Valve should “crack” at a pressure **within the range of positive cracking pressure as described in CP-201 section 3** ~~OF APPROXIMATELY 3.00 INCHES H₂O~~. This is marked by a sudden drop in pressure ~~OR AT WHICH PRESSURE STABILIZES~~. ~~ALLOW THE PV VALVE TO CONTINUE CRACKING FOR AT LEAST THIRTY (30) SECONDS WHILE MAINTAINING THE FLOW RATE.~~ Record the ~~FINAL~~ **cracking** pressure **(highest pressure achieved)** on the data sheet and close the control valve.
- 7.4 Negative ~~FOUR-INCH~~ Leak Rate. Open the control valve on the Negative Flow Metering device until the pressure ~~IN THE TEST STAND~~ stabilizes at **the negative leak rate pressure described in CP-201 section 3** ~~NEGATIVE FOUR (-4.00) INCHES H₂O~~. Maintain steady state pressure ~~AT -4.00 INCHES H₂O~~ by using the control valve for at least ~~THIRTY~~ **ten (30)** seconds. Steady state flow is indicated by a pressure change of no more than 0.05 inches H₂O on the pressure gauge. Record the final flow rate on the data sheet and close the control valve.
- 7.5 Negative Cracking Pressure. **Open the bypass valve to route the flow outside of the test assembly.** Open the control valve on the Negative Flow Metering device to establish a negative flow rate of 200 ml/min. **Once flow is stabilized, close the bypass valve to route the flow into the test assembly.** Observe the ~~TEST STAND~~ pressure. The ~~PV~~ **P/V** Valve should “crack” at a pressure **within the range of negative cracking pressure as described in CP-201 section 3** ~~OF APPROXIMATELY -8.00 INCHES H₂O~~. This is marked by a sudden drop in vacuum ~~OR AT WHICH VACUUM STABILIZES~~. ~~ALLOW THE PV VALVE TO CONTINUE CRACKING FOR AT LEAST THIRTY (30) SECONDS WHILE MAINTAINING THE FLOW RATE.~~ Record the ~~FINAL~~ **cracking** pressure **(highest vacuum achieved)** on the data sheet and close the control valve.

8. POST-TEST PROCEDURES

- 8.1 Remove the ~~PV~~ **P/V** Valve from the test ~~STAND~~ **assembly**.

8.2 Disassemble the pressure regulator from the compressed nitrogen cylinder (if used) and place the safety cap back on the cylinder.

8.3 Disassemble all remaining test equipment and store in a protected location.

9. CALCULATING RESULTS

9.1 Commonly used flow rate conversions:

$$1 \text{ CFH} = 471.95 \text{ ml/min}$$

Example: Convert 0.17 CFH to ml/min:

$$0.17 \text{ CFH} (471.95) = 80 \text{ ml/min}$$

$$1 \text{ ml/min} = 0.00212 \text{ CFH}$$

Example: Convert 100 ml/min to CFH:

$$100 \text{ ml/min} (0.00212) = 0.21 \text{ CFH}$$

10. REPORTING RESULTS

10.1 Record the station or location name, address and ~~TIME OF TEST~~ **tester information** on Form 1.

10.2 Record the ~~PV~~ **P/V** Valve manufacturer's name and model number on Form 1.

10.3 Record the results of the test(s) on Form 1. Use additional copies of Form 1 if needed to record additional ~~PV~~ **P/V** Valve tests.

10.4 Alternate data sheets ~~or~~ **OF** Forms may be used provided they contain the same parameters as identified on Form 1.

10.5 Use the formulas and example equation provided in Section 9 to convert the flow measurements into units of cubic feet per hour (CFH).

10.6 For certification testing, compare results to the performance standards listed in Table 3-1 of CP-201. For compliance testing, compare the results to the manufacturer's specifications listed on the ~~PV~~ **P/V** Valve for both leak rate and cracking pressure. For volumetric leak rates less than the manufacturers specified leakrate and cracking pressures within the manufacturers specified range, circle Pass on the data sheet where provided. If either the volumetric leak rate or cracking pressure exceeds the manufacturers specifications, circle Fail on the data sheet where provided.

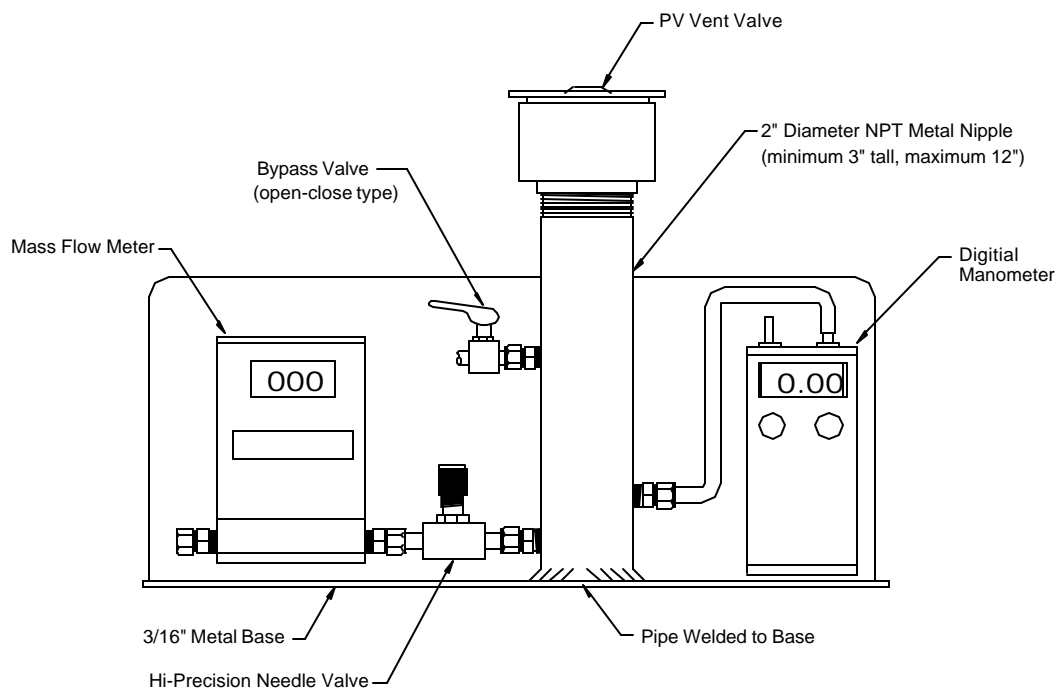
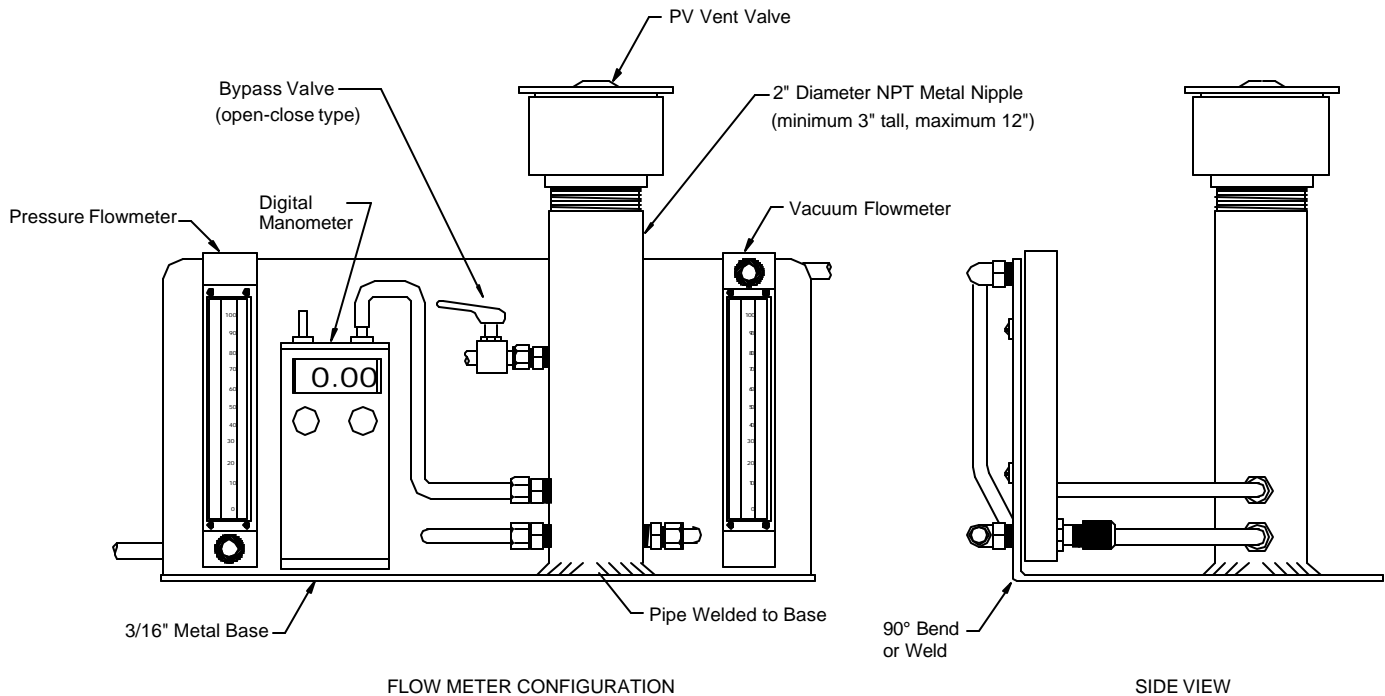
11. ALTERNATIVE TEST PROCEDURES

This procedure shall be conducted as specified. Any modifications to this test procedure shall not be used unless prior written approval has been obtained from the ARB Executive Officer pursuant to section 14 of CERTIFICATION PROCEDURE CP-201.

[ADD FIGURE BELOW]

Figure 1

Example of Test Stand

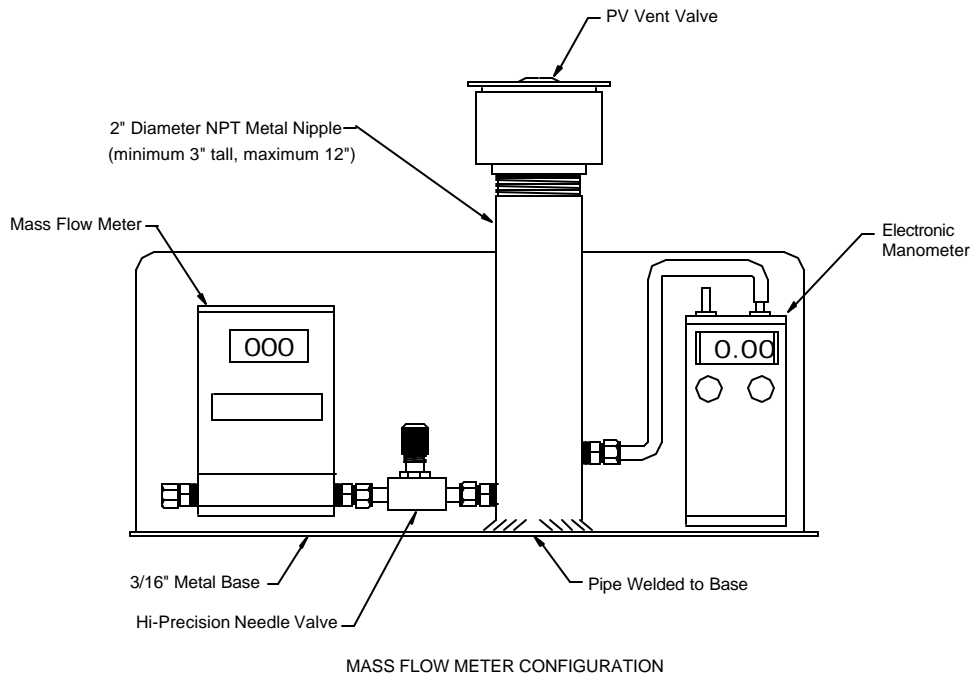
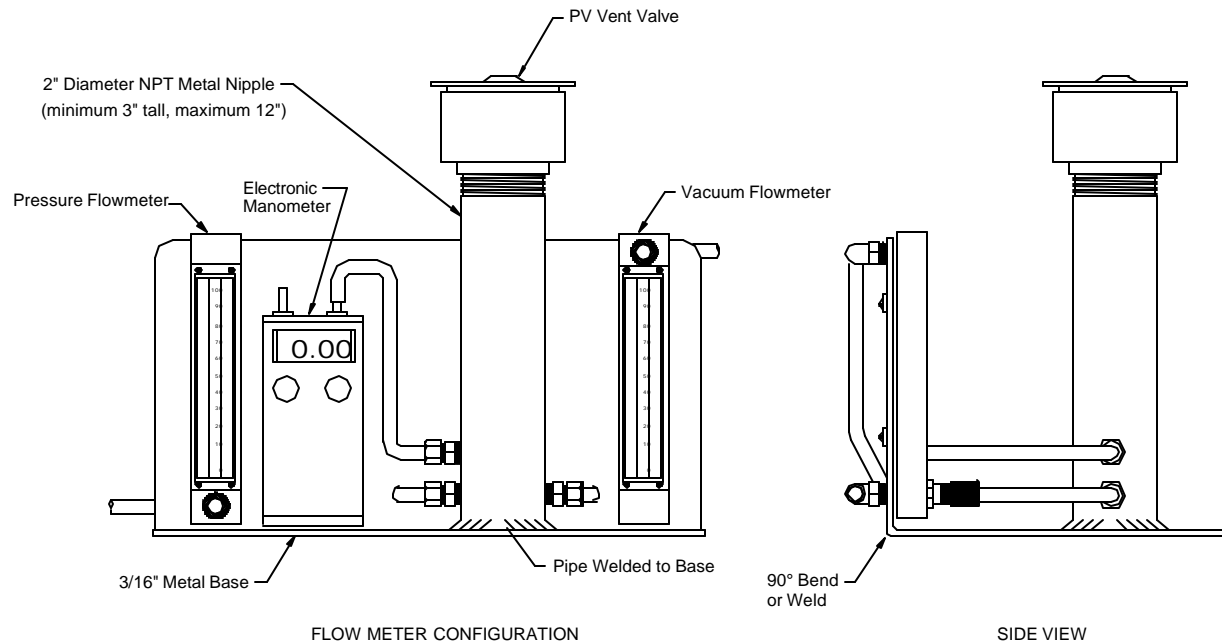


MASS FLOW METER CONFIGURATION

[DELETE FIGURE BELOW]

FIGURE 1

EXAMPLE OF TEST STAND



Form 1

~~PRESSURE-VACUUM~~ Pressure/Vacuum (P/V) Vent Valve Data Sheet

Facility Name:	Test Date:
Address:	TIME OF TEST Test Company.
City :	OTHER Tester Name

P/V P/V Valve Manufacturer:	Model Number:	Pass Fail
Manufacturers Specified 2.00 INCH Positive Leak Rate (CFH):	Manufacturers Specified -4.00 INCH Negative Leak Rate (CFH):	
Measured 2.00 INCH Positive Leak Rate (CFH):	Measured -4.00 INCH Negative Leak Rate (CFH):	
Positive Cracking Pressure (in. H ₂ O):	Negative Cracking Pressure (in. H ₂ O):	

P/V P/V Valve Manufacturer:	Model Number:	Pass Fail
Manufacturers Specified 2.00 INCH Positive Leak Rate (CFH):	Manufacturers Specified -4.00 INCH Negative Leak Rate (CFH):	
Measured 2.00 INCH Positive Leak Rate (CFH):	Measured -4.00 INCH Negative Leak Rate (CFH):	
Positive Cracking Pressure (in. H ₂ O):	Negative Cracking Pressure (in. H ₂ O):	

P/V P/V Valve Manufacturer:	Model Number:	Pass Fail
Manufacturers Specified 2.00 INCH Positive Leak Rate (CFH):	Manufacturers Specified -4.00 INCH Negative Leak Rate (CFH):	
Measured 2.00 INCH Positive Leak Rate (CFH):	Measured -4.00 INCH Negative Leak Rate (CFH):	
Positive Cracking Pressure (in. H ₂ O):	Negative Cracking Pressure (in. H ₂ O):	

P/V P/V Valve Manufacturer:	Model Number:	Pass Fail
Manufacturers Specified 2.00 INCH Positive Leak Rate (CFH):	Manufacturers Specified -4.00 INCH Negative Leak Rate (CFH):	
Measured 2.00 INCH Positive Leak Rate (CFH):	Measured -4.00 INCH Negative Leak Rate (CFH):	
Positive Cracking Pressure (in. H ₂ O):	Negative Cracking Pressure (in. H ₂ O):	